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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION &
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

October 18, 1991

NRC INFORMATION NOTICE 91-66: (1) ERRONEOUS DATA IN "NUCLEAR SAFETY GUIDE, TID-7016, REVISION 2," (NUREG/CR-0095, ORNL/NUREG/CSD-6 (1978)) AND (2) THERMAL SCATTERING DATA LIMITATION IN THE CROSS-SECTION SETS PROVIDED WITH THE KENO AND SCALE CODES

Addressees

All fuel cycle licensees, critical mass licensees, interim spent fuel storage licensees, and all holders of operating licenses or construction permits for test, research, and nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to errors in a common reference for nuclear criticality safety and to potential problems resulting from limitations in a common cross-section library used in support of criticality safety. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore no specific action or written response is required.

Description of Circumstances

(1) Erroneous data exists in the "Nuclear Safety Guide, TID 7016, Revision 2," further identified as NUREG/CR-0095, ORNL/NUREG/CSD-6 (1978). Table 2.8 of this guide presents calculated subcritical limits for mixtures of U(93.5) metal, water, and graphite. The values in the table had intended to indicate limits corresponding to a multiplication factor of 0.95. However, two independent groups working with such mixtures discovered errors in the table. Calculations performed at Oak Ridge National Laboratory (ORNL) suggested that limits presented in the table correspond to multiplication factors as high as 1.09. ORNL has generated a corrected table. Validation was based on an extrapolation of experimental data for U(100) mixtures. Copies of the corrected table may be obtained from G. Elliot Whitesides, Site Manager, Computing and Telecommunications Division, Oak Ridge National Laboratory, Post Office Box 2008, Oak Ridge, Tennessee 37831.

(2) Holtec International notified ORNL of a discrepancy between CASMO-3 and NITAWL-KENO-V.a calculations involving fuel storage at elevated temperatures.

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Subsequently, the Nuclear Engineering Application Division (NEAD) of ORNL confirmed the discrepancy and released the following article in the July 1991, SCALE Newsletter:

THERMAL SCATTERING DATA LIMITATION

Stan Turner of Holtec International brought to the attention of NEAD a discrepancy between KENO-V.a and CASMO-3 calculations for light-water reactor fuel assemblies in a storage configuration as a function of temperature. The two codes were in relative agreement at low temperatures (20°C) and small water gaps between assemblies. However, as the temperature of the system was increased to 120°C, the CASMO calculations gave increasingly larger values of k_{eff} relative to KENO. Larger water gaps (between assemblies) enhanced the temperature effects on calculated k_{eff} . The KENO results were as much as 3% lower than CASMO at 120°C.

The cause of this discrepancy has been identified as a limitation in processing the thermal scattering data when NITAWL makes a working library. The SCALE 27-group ENDF/B-IV hydrogen has scattering matrices at 293 K and 550 K (20°C and 277°C). When NITAWL processes hydrogen, the scattering matrix with a temperature closest to that specified is used. Room temperature hydrogen (293 K) was used by NITAWL in all of the calculations performed by Turner.

WORKER, a new SCALE module under development, was used to interpolate the thermal scatter matrix for one of the 120°C cases and the effective multiplication factor agreed to within 0.5% of the CASMO-3 value. Thus, it appears that the temperature dependence of the scattering can increase the multiplication factor by approximately 2.5%. Another KENO case was run with the 277°C scattering matrix and resulted in an additional increase of 1.7% in k_{eff} which was conservative in comparison to CASMO. Users should be aware of this problem and ensure that the hydrogen scattering matrices used in their analyses are either appropriate or conservative with respect to k_{eff} .

With regard to the other criticality libraries in SCALE, hydrogen has kernels at 295 K and 345 K in the 123-group library and only at room temperature in the 16-group library. Information on the thermal kernels for other nuclides may be found in Section M4 of the SCALE manual.

No changes are planned for any of the existing SCALE-4 cross section libraries, but there are plans to eventually release new ENDF/B-V cross section libraries which will have hydrogen kernels at 296, 350, 400, 450, 500, 600, 800, and 1,000 K.

Discussion of Safety Significance

There may exist criticality safety evaluations that are based on the incorrect data provided in the Nuclear Safety Guide, TID-7016, or on calculations with

inappropriate hydrogen scattering matrices. It is possible that some evaluations are significantly nonconservative. User review of those evaluations for continuing operations would ensure that adequate safety margins are retained.

For safety calculations, it is important for users to adequately validate the code, physics data, and modeling methods, for the intended application, with appropriate experiments. It is important to recognize the limitations of computer programs and cross-section libraries.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate NRC project manager.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

John F. Greaves for

Richard E. Cunningham, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
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Attachments:

1. List of Recently Issued NRC Information Notices
2. List of Recently Issued NMSS Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-65	Emergency Access to Low-Level Radioactive Waste Disposal Facilities	10/16/91	All NRC licensees.
91-64	Site Area Emergency Resulting From a Loss of Non-Class 1E Uninterruptible Power Supplies	10/09/91	All holders of OLs or CPs for nuclear power reactors.
91-63	Natural Gas Hazards at Fort St. Vrain Nuclear Generating Station	10/03/91	All holders of OLs or CPs for nuclear power reactors.
91-62	Diesel Engine Damage Caused by Hydraulic Lockup Resulting from Fluid Leakage Into Cylinders	09/30/91	All holders of OLs or CPs for nuclear power reactors.
91-61	Preliminary Results of Validation Testing of Motor-Operated Valve Diagnostic Equipment	09/30/91	All holders of OLs or CPs for nuclear power reactors and motor-operated valve (MOV) diagnostic equipment vendors identified herein.
91-60	False Alarms of Alarm Ratemeters Because of Radiofrequency Interference	09/24/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.
91-59	Problems with Access Authorization Programs	09/23/91	All holders of OLs or CPs for nuclear power reactors.
91-58	Dependency of Offset Disc Butterfly Valve's Operation on Orientation with Respect to Flow	09/20/91	All holders of OLs or CPs for nuclear power reactors.

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91-49	Enforcement of Safety Requirements for Radiographers	08/15/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.
91-44	Improper Control of Chemicals in Nuclear Fuel Fabrication	07/07/91	All nuclear fuel facilities
91-39	Compliance with 10 CFR Part 21, "Reporting of Defects and Noncompliance"	06/17/91	All Nuclear Regulatory Commission (NRC) material licensees.
91-35	Labeling Requirements for Transporting Multi-Hazard Radioactive Materials	06/07/91	All U.S. Nuclear Regulatory Commission (NRC) licensees.
91-30	Inadequate Calibration of Thermoluminescent Dosimeters Utilized to Monitor Extremity Dose at Uranium Processing and Fabrication Facilities	04/23/91	All fuel cycle licensees routinely handling unshielded uranium materials.
91-26	Potential Nonconservative Errors in the Working Format Hansen-Roach Cross-Section Set Provided with The Keno and Scale Codes	04/02/91	All fuel cycle licensees and other licensees, including all holders of operating licenses for nuclear power reactors, who use physics codes to support criticality safety in the use of fissile material.

inappropriate hydrogen scattering matrices. It is possible that some evaluations are significantly nonconservative. User review of those evaluations for continuing operations would ensure that adequate safety margins are retained.

For safety calculations, it is important for users to adequately validate the code, physics data, and modeling methods, for the intended application, with appropriate experiments. It is important to recognize the limitations of computer programs and cross-section libraries.

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